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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Zhu et al.

Attorney Docket No.: NOVLP090

Patent: 7,163,896 B1

Issued: January 16, 2007

Title: BIASED H2 ETCH PROCESS IN  
DEPOSITION-ETCH-DEPOSITION GAP FILL

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the U.S. Postal Service with sufficient postage as first class mail on August 16, 2007 in an envelope addressed to the Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450.

Signed: \_\_\_\_\_

Aurelia M. Sanchez

**REQUEST FOR CERTIFICATE OF CORRECTION  
OF OFFICE MISTAKE  
(35 U.S.C. §254, 37 CFR §1.322)**

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450  
Attn: Certificate of Correction

**Certificate  
AUG 23 2007  
of Correction**

Dear Sir:

Attached is Form PTO-1050 (Certificate of Correction) at least one copy of which is suitable for printing. The errors together with the exact page and line number where the errors are shown correctly in the application file are as follows:

**COVER PAGE:**

1. In the (75) Inventors section, change "Pingsheng, Sun" to --Pinsheng, Sun--. This appears correctly in the Corrected Filing Receipt as mailed on April 28, 2004.

**SPECIFICATION:**

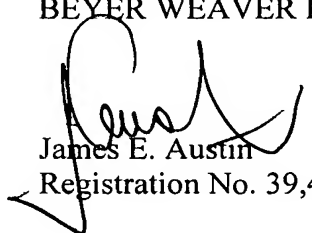
1. Column 7, line 57, change "2000" to --200--. This appears correctly in the patent application as filed on December 10, 2003 on page 12, line 5.

**AUG 23 2007**

Patentee hereby requests expedited issuance of the Certificate of Correction because the error lies with the Office and because the error is clearly disclosed in the records of the Office. As required for expedited issuance, enclosed is documentation that unequivocally supports the patentee's assertion without needing reference to the patent file wrapper.

It is noted that the above-identified errors were printing errors that apparently occurred during the printing process. Accordingly, it is believed that no fees are due in connection with the filing of this Request for Certificate of Correction. However, if it is determined that any fees are due, the Commissioner is hereby authorized to charge such fees to Deposit Account 50-0388 (Order No. NOVLP090).

Respectfully submitted,  
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AUG 23 2007



## UNITED STATES PATENT AND TRADEMARK OFFICE

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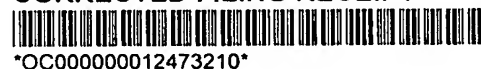
| APPL NO.   | FILING OR 371<br>(c) DATE | ART UNIT | FIL FEE REC'D | ATTY. DOCKET NO     | DRAWINGS | TOT CLMS | IND CLMS |
|------------|---------------------------|----------|---------------|---------------------|----------|----------|----------|
| 10/733,858 | 12/10/2003                | 2812     | 900           | NOVLP090/NVLS002888 | 6        | 20       | 2        |

CONFIRMATION NO. 7860

022434

BEYER WEAVER & THOMAS LLP  
P.O. BOX 778  
BERKELEY, CA 94704-0778

CORRECTED FILING RECEIPT



\*OC000000012473210\*

Date Mailed: 04/28/2004

Receipt is acknowledged of this regular Patent Application. It will be considered in its order and you will be notified as to the results of the examination. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please write to the Office of Initial Patent Examination's Filing Receipt Corrections, facsimile number 703-746-9195. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections (if appropriate).**

**Applicant(s)**

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**Assignment For Published Patent Application**

Novellus Systems, Inc.;

**Domestic Priority data as claimed by applicant****Foreign Applications**

If Required, Foreign Filing License Granted: 03/17/2004

Projected Publication Date: Request for Non-Publication Acknowledged

Non-Publication Request: Yes

Early Publication Request: No



JANIEA

AUG 23 2007

**Title**

Biased H2 etch process in deposition-etch-deposition gap fill

**Preliminary Class**

438

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Title 35, United States Code, Section 184  
Title 37, Code of Federal Regulations, 5.11 & 5.15**

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AUG 23 2007

the biased H<sub>2</sub> etch-enhanced gap fill process noted below showing that there is only trace amount of C (30ppm), N (20ppm) and F (10ppm) contained in the film relative to the SiO<sub>2</sub> film density of 7E+22 atoms/cc.

Biased H<sub>2</sub>-Etch Enhanced deposition conditions for SIMS analysis sample

5

| Parameter                 | Deposition 1 | Etch | Deposition 2 |
|---------------------------|--------------|------|--------------|
| Wafer temp (°C)           | 550          | 650  | 650          |
| SiH <sub>4</sub> (sccm)   | 80           |      | 80           |
| H <sub>2</sub> (sccm)     | 100          | 800  | 100          |
| He (sccm)                 | 200          | 300  | 200          |
| O <sub>2</sub> (sccm)     | 110          | 0    | 110          |
| Pressure (mTorr)          | 2.5          | 7.0  | 2.5          |
| Bias (HF RF)<br>Power (W) | 1100         | 3000 | 3100         |
| Source (LF)<br>Power (W)  | 3000         | 4000 | 3000         |

In addition, application of bias power to the wafer leads more etching radicals to move towards the etched target (wafer) so that etch back is enhanced. As shown in Fig. 3, etch rate increases with increase of the bias power.

10 Another advantageous characteristic of the biased H<sub>2</sub> etch-enhanced gap fill process of the invention is that etch-induced bottom-up deposition loss is minimum. This is illustrated in Fig. 4 which depicts etch amount inside and outside of a trench vs. etch time. Thus, as previously illustrated in Fig. 1, biased H<sub>2</sub> etch back of deposition on the trench top (overhang and top-hat) is much faster than that inside the  
15 trench. This is desirable to minimize gap fill deposition loss during the etch stage of the multi-step process. Secondly, etch amount of deposition on the trench top increases with time, while it remains unchanged for the bottom-up gap fill at the normalized time  $\geq 1.0$ .

20 Thus, this invention provides an etch-enhanced HDP gap fill (e.g., STI) process with an *in situ* high throughput H<sub>2</sub> etch step without C, N and F contamination.

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(Also Form PT-1050)

## UNITED STATES PATENT AND TRADEMARK OFFICE CERTIFICATE OF CORRECTION

PATENT NO. : 7,163,896 B1

Page 1 of 1

DATED : January 16, 2007

INVENTOR(S) : Zhu et al.

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

### In the Cover Page:

In the (75) Inventors section, change "Pingsheng, Sun" to --Pinsheng, Sun--.

### In the Specification:

Column 7, line 57, change "2000" to --200--.

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PATENT NO. 7,163,896 B1

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1/16/07